GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[X] ORIGINAL [ ] REVISION NO. ______

Project No./(Center No.) G-42-627/R6260-0A0 GTRC/XXXX DATE 2 / 16 / 87

Project Director: Dr. Christopher K. Hertzog School/XXX Psychology

Sponsor: DHHS/PHS/NIH/National Institute on Aging

Agreement No.: 2 R01 AG06123-03

Award Period: From 2/1/87 To 1/31/88 (Performance) 4/30/88 Reports

Sponsor Amount:

	New With This Change	Total to Date
Contract Value:	$	$ 192,814
Funded:	$	$ 192,814

Cost Sharing No./(Center No.) ______ Cost Sharing: $ ______

Title: Aging and Cognitive Correlates of Intelligence

ADMINISTRATIVE DATA

OCA Contact E. Faith Gleason

1) Sponsor Technical Contact:

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Military Security Classification: ______
(or) Company/Industrial Proprietary: ______

ONR Resident Rep. is ACO: ______ Yes X No
Defense Priority Rating: ______

RESTRICTIONS

See Attached NIH Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with GIT. No equipment may be purchased within the last six months of the Final Year of an NIH grant.

COMMENTS:

Continuation of G-42-622. Annual Report for prior project submitted with proposal for this 3rd year of the grant.

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FORM OCA 65:1086

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEET

Date 4/7/88

Project No. G-42-627 School/~~Lab~~ Psychology

Includes Subproject No.(s) N/A

Project Director(s) C. K. Hertzog GTRC/~~GIT~~

Sponsor DHHS/PHS/NTH/National Institute on Aging

Title Aging and Cognitive Correlates of Intelligence

Effective Completion Date: 1/31/88 (Performance) 4/30/88 (Reports)

Grant/Contract Closeout Actions Remaining: Note: 20 Pat Heitmuller
See profs from Faith Gleason

- [ ] None
- [x] Final Invoice or Copy of Last Invoice Serving as Final
- [ ] Release and Assignment
- [ ] Final Report of Inventions and/or Subcontract: Patent and Subcontract Questionnaire sent to Project Director [ ]
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other

Continues Project No. G-42-622 Continued by Project No. G-42-601

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6-42-627

Hertzog, Christopher Knox 527-02-7848

C. Progress Report

Publications

The following published papers, reprints, and unpublished manuscripts were written and/or published during the period of support provided by the current research grant (Note: publications related to a second research grant, "Short-term change in memory and metamemory in the elderly," PHS Grant # 7-R01-AG06162-01, are not listed — see Biographical Sketch for these publications):

Borgatta, E. F., & Hertzog, C. (1985). Introduction: Methodology and aging research. Research on Aging, 7, 3-6.

Hertzog, C. (1985). An individual differences perspective: Implications for cognitive research in gerontology. Research on Aging, 7, 7-45.

Hertzog, C. (1985). Applications of confirmatory factor analysis to the study of intelligence. In D. K. Detterman (Ed.), Current topics in human intelligence. Norwood, NJ: Ablex.

Hertzog, C., & Rovine, M. (1985). Repeated measures analyses in developmental research: Selected issues. Child Development, 56, 787-810.

Schaie, K. W., & Hertzog, C. (1985). Measurement in the psychology of adulthood and aging. In J. E. Birren & K. W. Schaie (Eds.), Handbook of the psychology of aging (2nd Edition). New York: Van Nostrand Reinhold.

Hertzog, C., & Schaie, K. W. (1986). Stability and change in adult intelligence: I. Analysis of longitudinal covariance structures. Psychology and Aging, 1, (in press).

Hertzog, C., & Nesselroade, J. R. (1986). Beyond autoregressive models: Some implications of the trait-state distinction for the structural modeling of developmental change. Manuscript submitted for a special section of Child Development on structural equation modeling.

Hertzog, C., Raskind, C. L., & Cannon, C. J. (1985). Adult differences in semantic information processing speed. Manuscript submitted for publication.

Schaie, K. W., & Hertzog, C. (1985). Toward a comprehensive model of adult intellectual development: Contributions of the Seattle Longitudinal Study. In R. J. Sternberg (Ed.), Advances in the Psychology of Human Intelligence (Volume 3). Hillsdale, NJ: Lawrence Erlbaum Associates (in press).

Copies of selected articles and manuscripts are provided in Appendix B.

Professional Personnel

1. Professional, Faculty Status

Christopher Hertzog, PhD.

2. Professional, Nonfaculty status

Harrisburg Staff: Angelica Brennan, Barbara Fernsler, Paul Rogers.

Secretaries: Maryanna Brown (Penn State), Patti Morgan (Georgia Tech).

3. Professional, in training status (graduate research assistants):

Cheryl Raskind (Penn State & Georgia Tech).

Summary:

Name	Title	Category	%Time
Christopher Hertzog (while at Penn State)	Asst. Prof.	1	X(<25%)
Christopher Hertzog (while at Georgia Tech)	Assoc. Prof	1	*(<25%)
Maryanna Brown	Secretary	2	X(26-50%)
Patti Morgan	Secretary	2	X "
Angelica Brennan	Proj. Coordntr.	2	X(51%-75%)
Paul Rogers	Systems Analyst	2	X(26-50%)
Barbara Fernsler	Research Tech.	2	X(75-100%)
Testers (Year 01 only)			
Mary Beth Romanoff	" "	2	X(< 25%)
Mary Louk	" "	2	X "
William Eason	" "	2	X "
Cheryl Raskind	Graduate Asst.	3	X (26-50%)
Hourly Students (Year 01 only)			
Constance Cannon		3	X (< 25%)
Thereasa French		3	X "
Vicki Harris		3	X "

Status Report of Current Research

The basic goal of the work funded under the current grant is
identify the relationship between information processing speed and
psychometric intelligence, in order to determine whether (1) indi
differences in psychometric intelligence in adult populations are
correlated with the speed of executing simple, basic cognitive pro
(2) age differences in a "speeded" set of psychometric measures
age differences in information processing speed; and (3) hypothes
from individual differences models of age changes in cognitive
processing speed are reflected in confirmatory factor analyses of
psychometric and RT tasks. On the one hand, the research can be
assessment of the potential constraints on inferences regarding
in intelligence. The central focus of our concern is the nature of
differences and age changes in performance on the Thurstone Prima
Abilities test used by Schaie in his Seattle Longitudinal Study
1983; Schaie & Hertzog, 1985b). The study was designed to determ
degree to which performance components (e.g., speed of using the
sheet, basic psychomotor speed) covary with PMA test performance.
degree of covariation between performance components and PMA test
groups would raise questions about what, exactly, is changing whe
performance declines with age. On the other hand, the PMA may be
valid, in the sense that basic skills are accurately being assess
PMA, but the PMA subtests may emphasize the speed of basic though
more than is realized (especially in the secondary literature, wh
SLS findings are usually discussed using implicit "power" concept
intelligence).

In the $1^1/_2$ years (to date) of the project, we have complet
following work: 1) run pilot studies validating the basic verbal
spatial information processing speed tasks in the target populat
conducted a large cross-sectional study of psychometric intellige
emphasizing the assessment of primary abilities of theoretical im
in evaluating the intellectual speed hypothesis; and 3) complete
collection on the microcomputer tasks for substantial undergradu
and adult alumni samples. We are currently analyzing the data fr
and 3 and are 4) running a second phase of data collection on the
microcomputer tasks. Given that we are now analyzing the bulk of
we cannot now report final results from the most important parts
project. It is our intention to provide an updated addendum on t
prior to study section review of this proposal. Preliminary res
special importance to the proposed continuation are reported bel

1) Pilot Study: Semantic Information Processing Speed

The first pilot study was designed to examine the
microcomputer-controlled RT tasks to be used to measure basic in
processing speed (simple RT and two-choice RT to nonverbal stimu
semantic information processing speed (a semantic verification t

semantic matching task, and a synonym matching task). The semantic verification task required a same/different discrimination of category-instance stimulus pairs (e.g., FRUIT - APPLE [same]; FRUIT - TROUT [different]). The semantic matching task measured instance-instance matches (e.g., APPLE - PEAR). The synonym matching task required subjects to judge whether two high frequency nouns had the same meaning (e.g., COOK - CHEF). These tasks have been studied in the aging literature with respect to the issue of slowing of semantic information processing, and have also been studied in the literature on information processing correlates of intelligence (e.g., Hunt, Davidson, & Lansman, 1981). We hypothesized that all three tasks were measuring a common individual differences dimension termed "semantic memory access speed," making them suitable as multiple measures of this dimension in latent variable models. Thus, we expected similar mean age differences on the tasks. We also hypothesized that the latent variable, SMA, would have similar properties in both young and old groups. Finally, we were interested in determining whether the correlations of the SMA factor with the simple RT and two-choice RT tasks would be higher in th e old group, as compared to the young group. A higher correlation would be predicted by the hypothesis of a common cause of slowing in information processing speed (Birren, Riegel, & Morrison, 1962; Hertzog, 1985). 30 young (undergraduate students) and 25 old subjects participated in the pilot study. All subjects took part in the five microcomputer tasks and also completed timed assessment of a limited set of the psychometric intelligence tests, including PMA Space, ETS Advanced Vocabulary, ETS Finding A's, ETS Hidden Patterns, and ETS Identical Pictures. Further description of the task procedures may be found in the paper, "Adult Age Differences in Semantic Information Processing Speed," included in Appendix B. This paper also contains tables of information summarized below.

The basic hypotheses were confirmed. First, age differences on the semantic tasks were quite similar. Second, the three semantic measures formed an SMA factor that was differentiated from the two-choice and simple RT factors. Third, this factor had equivalent factor loadings in both age groups. Fourth, we found that the correlations among the three RT factors differed between the age groups. The two-choice factor and the SMA factor correlated more highly in the old, whereas the simple RT factor was less correlated with both choice-RT factors in the old. Certainly, these preliminary results were encouraging, but relatively small differences in correlations, as well as the small sample sizes of the pilot study, underscored the need for replication in the main study.

Table 1 provides the correlations of the psychometric tests with the RT tasks. An interesting pattern emerges in the old. Individual differences in the semantic RT tasks were not more highly predictive of the Advanced Vocabulary test than was the two-choice RT task with nonverbal stimuli! This finding, if replicated in the larger study, would have profound implications for interpretation of speed-verbal intelligence relationships. This point is elaborated in the project proposal below.

Table 1

Correlations of RT with Intelligence Tests:
Harrisburg Pilot Study

Young Group (n = 30)

	Adv. Vocabulary	Space	Finding A's	Identical Pictures
CATVH	-.13	.02	-.24	-.22
CATVL	-.29	-.09	-.22	-.30
SEMH	-.23	-.06	-.33	-.37
SEML	-.32	.06	-.19	-.54
SYN	-.15	-.05	-.15	-.40
TWOCH	.28	.16	-.31	-.06

Older Group (n = 30)

	Adv. Vocabulary	Space	Finding A's	Identical Pictures
CATVH	-.22	-.35	-.06	-.15
CATVL	-.36	-.39	-.16	-.13
SEMH	-.18	-.45	-.11	-.23
SEML	-.28	.46	-.03	-.05
SYN	-.32	-.30	-.25	-.28
TWOCH	-.27	-.45	-.01	-.11

Note: Correlations appear to differ between groups, with higher correlations of spatial and vocabulary scores with RT in the older group. Given the small N, these differences may not be stable. However, there is no indication that there is a higher relationship of SMA to Vocabulary, or that SMA correlates more highly with intelligence than does the non-verbal two-choice RT task.

Abbreviations:
CATVH -- category verification RT task, high typicality
CATVL -- category verification RT task, low typicality
SEMH -- semantic matching RT task, high typicality
SEML -- semantic matching RT task, low typicality
SYN -- synonym matching RT task
TWOCH -- two-choice RT task
SMA -- Semantic Memory Access factor

2) Cross-sectional study of psychometric intelligence

The second part of the study consisted of an administration of a large battery of psychometric tests to a cross-sectional sample of adults and undergraduate students. The battery was designed to measure multiple indicators of a) the primary ability factors assessed in Thurstone's PMA (Verbal Comprehension, Spatial Relations, Induction, and Numerical Facility), b) additional visuo-spatial abilities (Spatial Visualization, Flexibility of Closure), and c) highly speeded abilities, including (Psychomotor Speed and Perceptual Speed). The full battery is listed in Table 2. The cross-sectional sample contained alumni of the Pennsylvania State University, age ranges 43-75, additional volunteers in the age range 43-90, drawn from the general Harrisburg community (Total adult N = 622), and a comparison group of undergraduate Penn State students (N = 211).

Analysis of these data is in progress. Means and standard deviations for selected tests, divided into arbitrary five-year birth cohorts (age groups), are given in Table 3. These data omit individuals older than age 75, who were, almost exclusively, non-alumni volunteers. The important point is that the "classic" cross-sectional pattern of mean differences observed in the literature is found in these data as well; namely, little or no cross-sectional differences on tests of Verbal Comprehension and Numerical Facility, but significant cross-sectional differences on measures of Induction, Spatial Relations, and Perceptual Speed. These data also show significant cross-sectional differences on Spatial Visualization and Flexibility of Closure. Large sex differences, favoring men, were found on the spatial and numerical factors, as predicted from the literature.

The cross-sectional age differences seem to be quite large for the difficult tests of Spatial Visualization. Indeed, we found that the proportion of older persons failing to solve correctly more visualization problems than they missed was remarkably high on both the Form Board and Paper Folding subtests. These results suggest that the age differences observed on tests of spatial rotation, as measured by the Spatial Relations factor, are not indicative of the magnitude of the age differences on Spatial Visualization tests, which typically place greater demands on the processing capacities of the individual. This finding plays an important role in the proposal outlined below.

One of the key predictions for the cross-sectional data was that the correlations of speeded abilities, especially the tests measuring the ability to mark correct answers on the PMA answer sheets, would correlate more highly with other test scores in the middle-aged and older adults than in the undergraduate students. In general, the correlations among the tests are higher in the adult sample, particularly for highly speeded subtests. Table 4 reports correlations of the answer sheet speed tests with PMA performance in both groups. The answer sheet speed tests appear to form a common factor that is more highly correlated with PMA performance

Table 2

Psychometric Battery in Harrisburg Study

Primary Ability	Measure	Source
Induction	PMA Letter Series	Thurstone & Thurstone, 1949
"	PMA Letter Sets	Thurstone & Thurstone, [illegible]
"	PMA Number Series	" " "
Spatial Relations	PMA Space	Thurstone & Thurstone, [illegible]
" "	Card Rotation	Ekstrom et al., 1976
" "	Cube Comparison	" "
" "	Object Rotation	Schaie/Thurstone test (STAMAT)
Spatial Visualization	Form Board	Ekstrom et al., 1976
" "	Paper Folding	" "
Verbal Comprehension	PMA Verbal Meaning	Thurstone & Thurstone, [illegible]
" "	Advanced Vocab. (V3)	Ekstrom et al., 1976
" "	Advanced Vocab. (V4)	" "
Perceptual Speed	Number Comparison	Ekstrom et al., 1976
" "	Picture Identity	" "
" "	Finding A's	" "
Flexibility of Closure	Hidden Patterns	Ekstrom et al., 1976
" "	Hidden Figures	" "
Number Facility	PMA Number	Thurstone & Thurstone, [illegible]
" "	Addition	Ekstrom et al., 1976
" "	Subtraction & Multiplication	" "
Psychomotor Speed	Crossing Digits Test	Hertzog and staff
" "	PMA Answer Sheet, VM	Adapted from Thurstone PMA
" "	PMA Answer Sheet, S	" " " "
" "	" " ", R	" " " "
" "	" " ", N	" " " "

Table 3

Means and Standard Deviations by Age and Gender
for Selected Intelligence Tests

Ages	N	PMA Space	Paper Folding	Form Board	PMA Reasoning	Sub/Mult	Adv. Vocabulary
70-75(M)	55	12.53(9.18)	-0.76(3.08)	-1.89(5.99)	4.91(8.09)	29.60(9.47)	15.31(9.72)
(F)	26	9.38(8.21)	-0.21(2.54)	-2.88(5.94)	5.38(9.72)	27.76(11.58)	13.76(13.17)
65-69(M)	57	17.21(10.29)	1.35(3.51)	1.49(7.06)	9.91(7.07)	31.61(9.12)	17.67(10.70)
(F)	51	12.27(7.76)	-0.14(3.23)	-1.75(7.16)	8.80(9.52)	27.43(12.61)	11.35(12.83)
60-64(M)	64	19.94(9.12)	2.05(3.21)	4.00(6.40)	11.36(6.93)	33.13(8.13)	14.48(8.65)
(F)	55	14.04(9.28)	0.42(3.21)	-0.87(6.45)	10.69(8.84)	29.45(9.72)	13.45(11.56)
55-59(M)	40	25.00(8.55)	3.15(3.38)	4.90(5.54)	14.00(6.35)	37.15(8.44)	15.03(9.26)
(F)	57	15.16(7.10)	0.56(3.15)	-0.30(5.69)	13.44(7.10)	32.48(10.26)	15.07(9.25)
50-54(M)	27	23.89(8.37)	3.67(4.17)	3.60(6.70)	15.67(6.79)	33.44(10.04)	14.67(6.71)
(F)	44	19.05(9.31)	1.30(3.64)	2.51(5.23)	15.48(6.95)	29.12(10.51)	15.53(9.96)
45-49(M)	32	23.50(8.97)	4.03(2.72)	5.03(8.06)	16.53(6.43)	33.69(10.43)	12.66(9.41)
(F)	41	20.80(11.18)	2.68(2.63)	2.15(6.96)	17.37(6.64)	34.03(9.90)	13.88(10.11)
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(F)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(F)	[illegible]	[illegible](12.96)	4.34(2.90)	3.5[illegible](6.19)	22.51(4.49)	29.31(8.58)	3[illegible](8.81)

Note: All tests are scored as Right - Wrong (commission errors).

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Table 4

Correlation Matrix of PMA Tests and
PMA Answer Sheet Components

	PMAR	PMAS	PMAV	PMAN	AN[illegible]	[illegible]S	[illegible]	ANSN
PMAR	-	.394	.252	.380	.1[illegible]	[illegible]9	[illegible]	.115
PMAS	.494	-	.257	.267	.1[illegible]	[illegible]4	[illegible]	.248
PMAV	.520	.365	-	.142	.0[illegible]	[illegible]8	[illegible]	.105
PMAN	.378	.286	.438	-	.1[illegible]	[illegible]1	[illegible]	.197
ANSR	.348	.258	.332	.234	-	[illegible]	[illegible]	.492
ANSS	.479	.450	.499	.392	.5[illegible]		[illegible]	.598
ANSV	.520	.422	.465	.331	.4[illegible]	[illegible]2		.539
ANSN	.518	.386	.432	.398	.5[illegible]	[illegible]	.[illegible]	-

Note: Correlations above the diagonal are for Penn State undergraduate; correlations below the diagonal are for the Penn State alumni sample.

Table 4

Correlation Matrix of PMA Tests and
PMA Answer Sheet Components

	PMAR	PMAS	PMAV	PMAN	ANSR	ANSS	ANSV	ANSN
PMAR	–	.394	.252	.380	.124	.209	.188	.115
PMAS	.494	–	.257	.267	.191	.344	.214	.248
PMAV	.520	.365	–	.142	.072	.158	.139	.105
PMAN	.378	.286	.438	–	.125	.301	.104	.197
ANSR	.348	.258	.332	.234	–	.676	.540	.492
ANSS	.479	.450	.499	.392	.581	–	.630	.598
ANSV	.520	.422	.465	.331	.484	.702	–	.539
ANSN	.518	.386	.432	.398	.550	.723	.672	–

Note: Correlations above the diagonal are for Penn State undergraduates; correlations below the diagonal are for the Penn State alumni sample.

in the old, as predicted. This hypothesis is part of the confirmatory factor analysis we are now conducting on the psychometric data.

3) The first microcomputer study

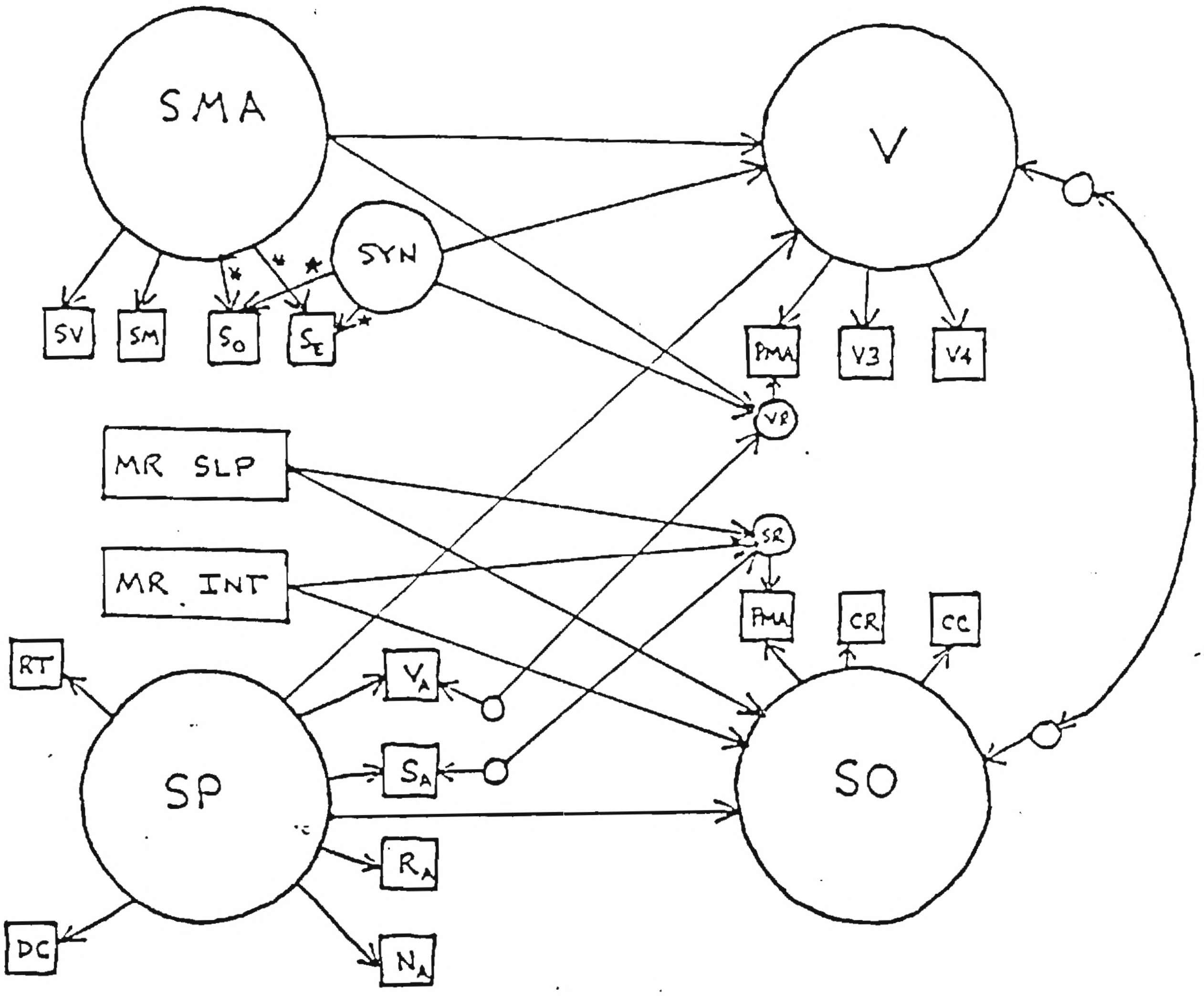
We recently completed testing of just over 150 individuals in a microcomputer task battery measuring simple RT, two-choice RT, semantic RT (the set of microcomputer tasks used in the pilot study), and the mental rotations task. Two separate blocks of synonym matching were given to provide additional data on this task, so that it can be related to recognition vocabulary test performance. 77 adults, ages 43 - 70, and 75 undergraduate students (from both Penn State and Georgia Tech) participated in the study. All these individuals had previously been tested on the full psychometric battery listed in Table 2. Analysis of these results is just beginning, with the first step being calculation of summary statistics describing the RT distributions. Given recent results that suggest relationships between intraindividual variability in RT and psychometric performance, we are extracting central tendency measures (mean and median RT) and variability (standard deviations, semi-interquartile range) from the data. In addition, slope and intercept parameters for the mental rotations task are being computed. We should be able to report preliminary results from our analysis (age correlations with RT tasks, etc.) in an addendum report to the study section prior to proposal review. After the preliminaries, a LISREL model, shown in Figure 1, will be used to test predictions of convergent/discriminant validity of verbal and spatial information processing speed/ability relationships. Results from our pilot study are very encouraging regarding the utility of this model.

4) The second microcomputer study

We have begun the second study, which differs in small but potentially important ways from the first study just completed. First, we have added an additional two-choice RT task. This task requires a Same/Different judgment on the direction of two arrows (as opposed to the other task, that requires a judgment of the direction of a single arrow). This task probably provides a better control task for the semantic and spatial RT tasks, as the type of judgement (a two-figure match) is identical. Preliminary results suggest this judgement requires about 200 msec more, on average, than the two-choice RT task on the direction of a single arrow. The important question is whether individual differences on this task relate more closely to the semantic RT tasks than did the other two-choice task, and if so, if the semantic RT factor can still be differentiated from the nonverbal two-choice task. Second, we are exploring the effects of accuracy and RT speed feedback on the individual differences results. In the first study, subjects were given trial by trial feedback on accuracy, but not RT. This is a relatively standard experimental procedure that maintains acceptably low error rates in student samples! However, we have observed some exceptionally slow response times in adults who appear to be conservative in their criterion for trading speed for accuracy. That is,

Figure 1

LISREL Model for Experimental Task/Intelligence Relationships*



*See next page for abbreviations codes and explanatory note.

they seem too willing to slow their response times in order to maximize accuracy. This opens the possibility that the distributions of RT parameters will be unduly influenced by individual differences in speed-accuracy criteria. To get some indication of this, we have adopted a different practice and experimental feedback strategy. During practice, subjects receive at least two blocks of practice trials. In the first, they receive trial by trial accuracy feedback to shape their responses. At the end of the first practice block, they receive feedback on both speed and accuracy. In the subsequent practice blocks, they receive only summed feedback on both speed and accuracy at the end of the block. No feedback is given during the experiment (only a neutral "thank you"). During the feedback at the end of practice blocks, experimenters emphasize both speed and accuracy. They reinforce verbally reductions in RTs from the first to the second practice block. The question is whether similar age differences in RT and in RT/psychometric test relationships will be observed under these somewhat different experimental procedures. We will have adequate sample sizes to test the invariance of the prediction equations over the two groups using a LISREL model.

SECTION IV PROGRESS REPORT SUMMARY	GRANT NUMBER 5 R01 AG06123 04	
PRINCIPAL INVESTIGATOR OR PROGRAM DIRECTOR Christopher Hertzog	PERIOD COVERED BY THIS REPORT	
APPLICANT ORGANIZATION Georgia Institute of Technology	FROM 2/1/86	THROUGH 1/31/87
TITLE OF PROJECT *(Repeat title shown in item 1 on first page)* Aging and Cognitive Correlates of Intelligence *(SEE INSTRUCTIONS)*	5-R01-AG06123-04	

1. Plans for next year of support:

(a) test 135 Penn State subjects in the second microcomputer study. These individuals, first tested in 1985/1986, will then have 2-year longitudinal data on both psychometric tests and microcomputer RT tasks;

(b) conduct large cross-sectional study in Atlanta (N=900), using a new, improved psychometric battery;

(c) begin large microcomputer RT task study of spatial visualization, spatial relations, and visual memory, using a subset of the Atlanta cross-sectional sample as subjects.

(d) conduct data analysis on the longitudinal data from the Penn State psychometric and first microcomputer study;

(e) complete analysis and writeup of data from first Penn State study (described briefly below under current studies).

2. Description of current studies:

(a) age differences in psychometric intelligence. We completed an analysis of cross-sectional data on psychometric intelligence for N=622 adults and N=211 students from Pennsylvania. Results are described in an upublished manuscript, The influence of cognitive slowing on age differences in intelligence, now in final revision for publication. Briefly, we found substantial relationships between perceptual speed and the speed of marking psychometric answer sheets to intelligence test performance in adults. We also found that age differences in more complex tests were substantially attenuated when partialling for these simple speeded abilities. Finally, we found evidence for a performance confound involving the Thurstone Verbal Meaning vocabulary test. This test correlates more strongly with answer sheet speed in older subjects than in middle-aged adult subjects, suggesting that speed becomes an increasingly important influence on Verbal Meaning performance with increasing age.

(b) age differences in the speed of mental rotation. We (Hertzog & Yuasa) recently completed an analysis of data from over 250 adults on mental rotation task performance. We find (1) significant age differences in the speed of mental rotation, both in the intercept and slope of the RT function. This difference does not, however, account for large proportions of variance. The age difference is in the form of a linear increase in the slope and intercept functions over the age range 43-78. Data for the second Penn State sample are depicted in Figure 1; (2) contrary to some studies, we do find significant age differences in error rates on the mental rotation task. This effect is modest and may have been obscured in other studies that have much smaller sample sizes. The age differences in error rates, across angles of rotation, are depicted in Figure 2; (3) both slope and intercept parameters

FIGURE 1

5 R01 AG06123 04
HERTZOG, Christophe

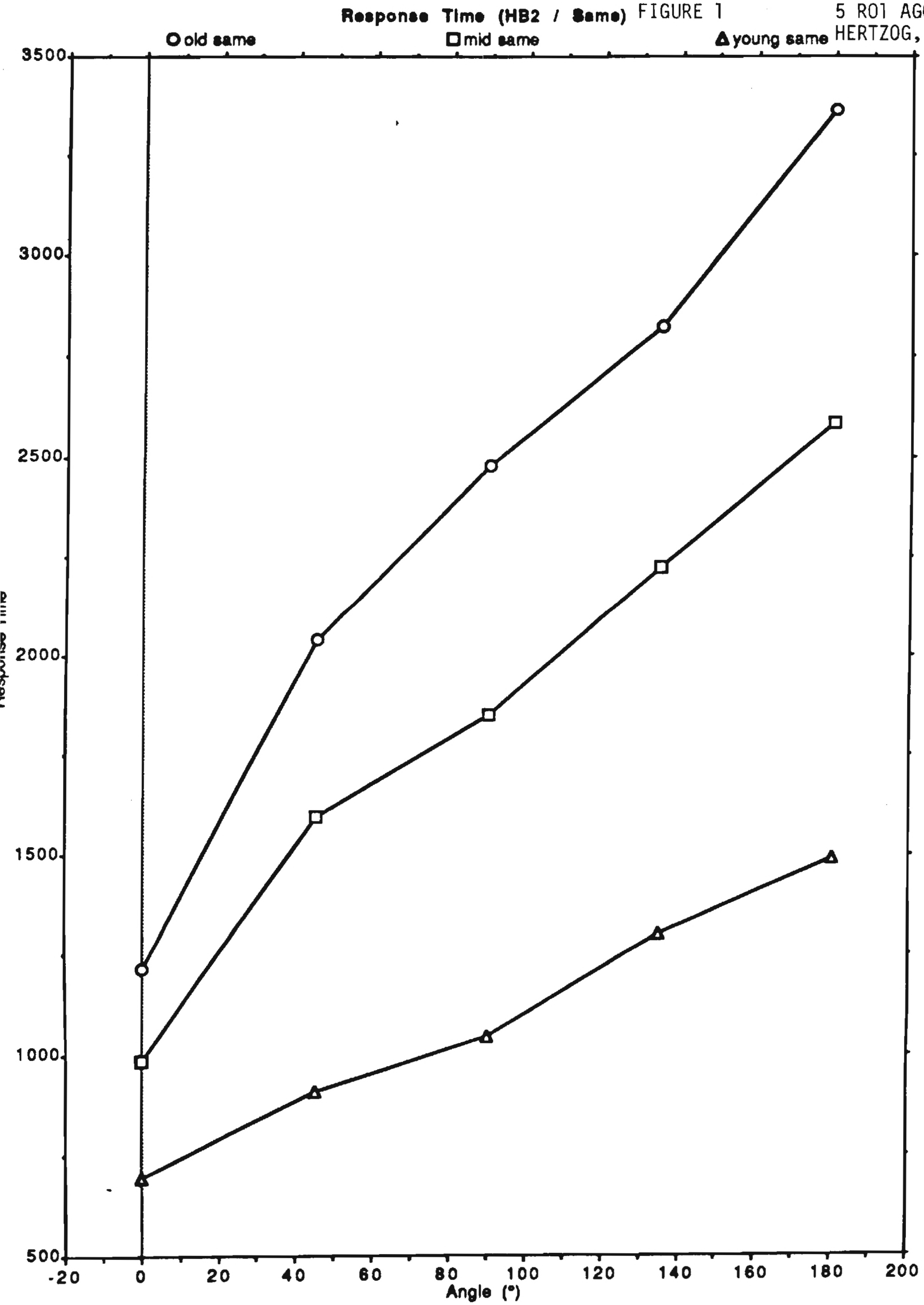
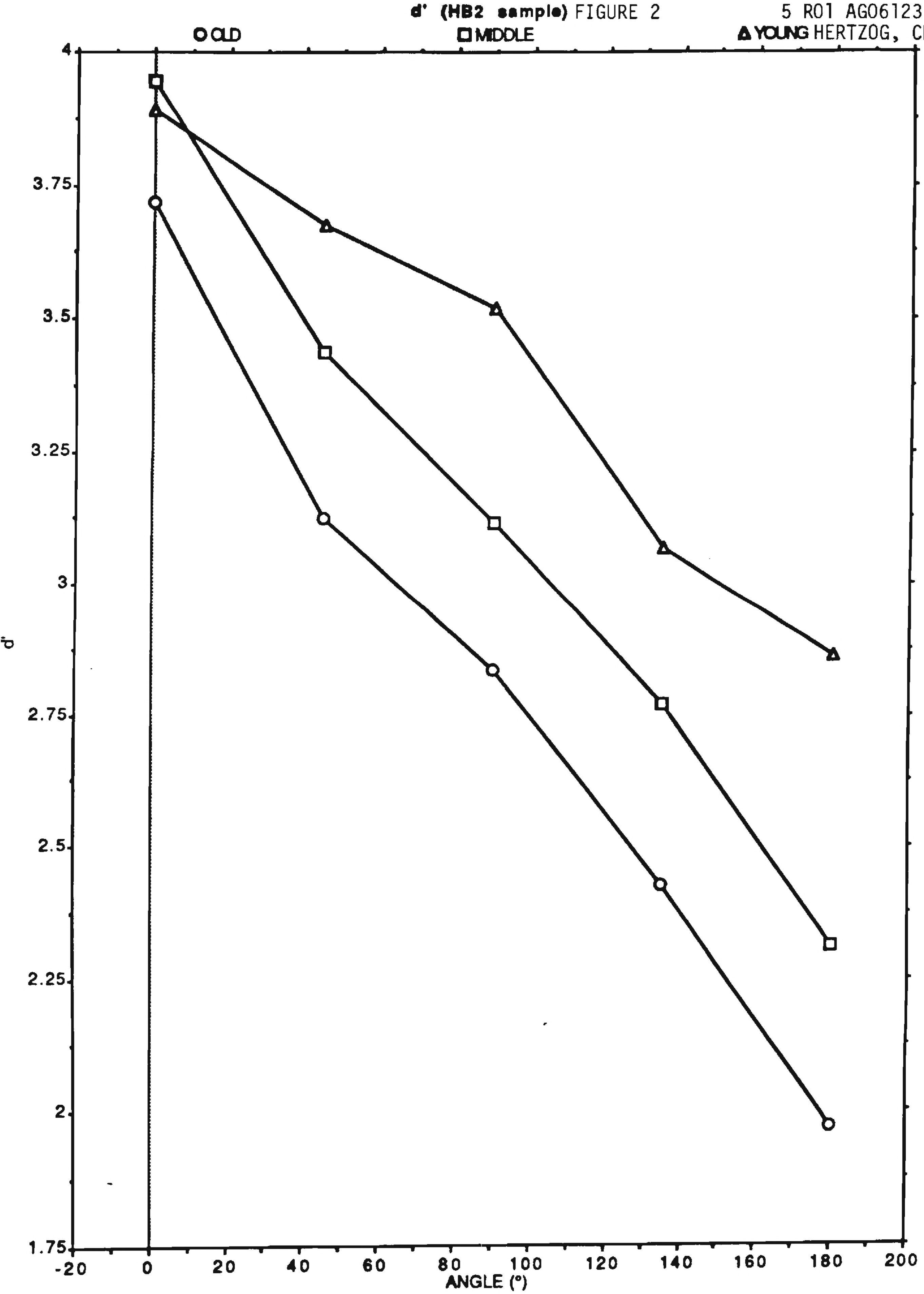


FIGURE 2 5 R01 AG06123 04
HERTZOG, Christopher



significantly correlate with spatial relations test performance in both college students and adults. However, there is a significant correlation of error rates with performance in the old, but not in the young. This may suggest some loss of rotation skill with aging that is independent of speed and reflected both in RT task and psychometric test performance. A manuscript describing these results is in progress; (4) we find substantial individual differences in the degree to which the linear function proposed by Shepard and Cooper fits individual data records. It appears that there may be qualitative individual differences in processing strategies, and that these may vary by age group. We are currently conducting multivariate cluster analyses on the RT data to determine if we can reliably identify types of RT patterns, and if these are associated with (i) different error rates over experimental conditions and (ii) differences in patterns of psychometric test performance.

(c) We (Hertzog and Uhlman) are currently completing an analysis of the other RT tasks in the microcomputer battery, prior to conducting overall structural regression analysis. Results indicate (1) replication of results reported by Hertzog et al. (1986), showing a semantic memory access speed factor that is distinct from nonverbal two-choice RT, (2) similar rates of cognitive slowing across different types of RT tasks, consistent with the general slowing hypothesis. The structural regression analyses planned will determine whether the data at the individual differences level is also consistent with the age differences in mean RT performance in pointing to a general slowing.

(d) We successfully completed a longitudinal retest of 452 adults from the Penn State study, first tested in 1985. These data will be analyzed in the next grant year. We have finished entering and verifying all these data on the Georgia Tech computer system, and are currently entering the personal data questionnaire on all subjects. This entry will be completed by the end of Year 03.

(e) We are currently retesting 60 of the 77 participants in the first Penn State microcomputer RT study. We have been able to get the high retest rate originally planned, and are currently about 2/3 of the way through testing this sample. Data are being uploaded to the Georgia Tech computer system as they are received from Penn State. We project completion of this testing by the end of Year 03, as originally proposed.

3. There have been no changes in Human Subjects protocols.

4. Not Applicable.

5. Publications:

Hertzog, C. (1987). Applications of structural equation models in gerontological research. In K. W. Schaie (Ed.), Annual review of gerontology and geriatrics (Vol. 7, pp. 265-293). New York: Springer.

Hertzog, C. & Nesselroade, J. R. (1987). Beyond autoregressive models: Some implications of the trait-state distinction for the structural modeling of developmental change. Child Development, 58, 93-109.

Hertzog, C. (in press). On the utility of structural regression models for developmental research. In P. B. Baltes, D. L. Featherman, & R. M. Lerner (Eds.), Life-span development and behavior (Vol. 10). Hillsdale, NJ: Lawrence Erlbaum Associates.

Hertzog, C. & Schaie, K. W. (in press). Stability and change in adult intelligence: 2. Simultaneous analysis of longitudinal means and covariance structures. Psychology and Aging.

Hertzog, C. (1987). Using confirmatory factor analysis for scale development and validation. Chapter under review for M. P. Lawton & R. Herzog (Eds.), Research methods in gerontological application. Baywood Press.

Hertzog, C. (1987). The influence of cognitive slowing on age differences in intelligence. Unpublished manuscript.